The number of Readers to be appointed is twenty-nine, distributed as follows :—

Divinity	2
Law	3
Medicine	2
Classics	4
Language	4
Mathematics	6
Physics and Chemistry	4
Natural Science	2
History	1
Moral Science	2

Of these not less than fourteen are to be appointed before the end of the year 1882, and the rest before the end of the year 1886.

The University may vary the connection of the Readers with the several Special Boards of Studies, and increase their number, upon the recommendation of the General Board of Studies.

The stipend of a Reader is 400*l.* a year, subject to variation by grace of the Senate upon the recommendation of the General Board of Studies, but no such variation shall affect the interest of a Reader without his consent, *or diminish the aggregate amount of payments to the whole body of Readers.*

The University is to have power to give pensions to retiring Readers according to circumstances, as the Senate may think fit.

Another arrangement for increasing the teaching power in the University is the appointment of University lecturers.

The General Board of Studies acting in conjunction with any Special Board may choose as Lecturers in the department of study for which the Special Board is formed such College Lecturers as they may think fit, who are willing, with the concurrence of their respective Colleges, to throw open their lectures to all students of the University.

The Lecturers so chosen are to be called University Lecturers, and each of them shall receive from the University an annual stipend of 50*l.*

No one is to be appointed to this office who does not receive from his College an annual stipend of at least 200*l.* as Lecturer, irrespective of the income of a Fellowship or other College emolument; the office of University Lecturer becomes *ipso facto* vacant if the holder of it ceases to hold the office of College Lecturer or receives from such office a less stipend than 200*l.* a year.

The number of University Lecturers and their connection with the Special Boards of Studies shall be determined from time to time, provided that when fit persons can be found the whole number shall be not less than thirty [one-half to be appointed before the end of the year 1882, and the rest before the end of the year 1884].

There is only one other point of the Statutes which we need analyse on the present occasion; this refers to the duties of Professors and Readers.

It is laid down that it shall be the duty of every Professor and Reader *as well to devote himself to research and the advancement of knowledge in his department* as to give lectures in every year.

It is impossible to estimate the good these words will do to the cause of research in England, where so many of our Professors sink to the level of mere traders. They should, though perhaps less necessary at Cambridge than elsewhere, be put up in letters of gold on the Senate House.

It will be sufficiently clear from the foregoing that with the great increase of teaching power which the Statutes confer the University should rise phœnix-like from its ashes, and that the present condition of things will be entirely changed.

How Cambridge in the new order of things will stand as compared with other Universities, and the lines along which future work and reforms may run, are questions so interesting that we may return to them and others on a future occasion.

AURORÆ

Auroræ: their Characters and Spectra. By J. Rand Capron, F.R.A.S. (London: E. and F. N. Spon, 1879.)

IN Mr. Gore's delightful book on the "Art of Scientific Discovery," it is said that "during the prosecution of an original investigation, the area of question and discovery enlarges as we proceed, and the research in some cases develops into such complexity and magnitude, that solution of its questions appears for a time hopeless. Generally, however, when that discouraging point is attained, the subject begins to clear, and by persistent research is gradually reduced to order, and is found to conform to a few general laws or principles."

The first part of this paragraph is only too apt a description of the present stage of the inquiry into the causes and nature of the Polar aurora. The striking character of the phenomenon itself, its evident connection with electric and magnetic disturbances, its unaccountable spectrum, and the relations which various observers have believed they had detected with solar spots, and coronal rays, are powerful stimulants to scientific curiosity. But so far the most painstaking researches have failed to seize the connecting link which should unite these various aspects into one organic whole; and we can only hope that the concluding sentence which we have quoted may be a prophesy of ultimate success. Under such circumstances Mr. Capron has done good service to science by collecting in a compact form the whole information which we possess on the subject, for it is only by careful study of what is already known that we can decide on the point of attack which gives the best hope of further conquest.

The first four chapters of the book are taken up with descriptions of specific auroræ. Among these we are sorry to miss a fuller account of the careful and accurate observations made by Lieut. Weyprecht during the Austrian Arctic Expedition of 1872-4. His description of arctic auroræ, as quoted from Payer's "New Lands Within the Arctic Circle," is exceedingly graphic and picturesque, but the original paper[1] as read before the Imperial Austrian Academy of Science, with its accurate classification of auroral forms, seems to have escaped the author's notice, as it is not even named in the list of papers in the appendix.

In Chapter V. the question of sound produced by the northern lights is discussed with the result that the balance of evidence is against it. Upon the height of

[1] "Die Nordlichtbeobachtungen der osterreichisch-ungarischen arctischen Expedition 1872-74," von Carl Weyprecht, vorger t 17 Mai, 1877.

auroræ the most diverse conclusions are quoted, trigonometrical measurements giving results varying from a few thousand feet up to 1,000 miles, while there are several well attested instances in which auroral rays have been seen actually between the observer and terrestrial objects. If these latter observations are correct it is evident that auroræ may be produced near the earth's surface, and consequently in air of considerable density. They are supported by the fact that the lower trigonometrical measurements are less liable to fallacy than the higher, since in the latter it may always be objected that observers at different stations might have seen different arches, or that the auroral arch in general is merely a perspective illusion produced by the termination of vast numbers of parallel rays at the same height. Additional observations of auroræ seen between the observer and mountain-tops or other elevated objects would be of great scientific interest.

Another very important line of inquiry noted by Mr. Capron is that of the connection of clouds and auroræ, some types of cirrus cloud so much resembling auroræ in their forms and arrangement that it is very probable that in some of the reported cases of daylight auroræ the observers may merely have noted arches of cirrus. On the other hand, it is by no means unlikely that some form of cloud, especially that which consists of small particles of ice, may be illuminated by electric discharges, and be the actual material basis of the phenomenon. In this connection the coincidence of auroræ with mock suns and similar appearances is of interest, since these indicate the presence of minute ice-crystals in the upper air. The Whitby fishermen, on September 23 of this year, reported a considerable aurora, and on the same night the moon, "prior to being obscured by clouds, seemed to shed a radiant glow straight up and down" (probably a rudimentary *paraselene*).[1] If aurora really is ever visible by daylight, it would seem almost incontestable that it must consist in some form of mist capable of reflecting as well as of emitting light, for the light of the brightest aurora is very inferior in *intensity* to that of the moon's surface, and the moon by daylight only appears like a faint white cloud. An aurora is a very brilliant one which lights the earth as brightly as the full moon, and yet it probably covers a great part of the sky, while the moon's diameter is only half a degree.

On p. 47 Mr. Capron summarises a most interesting investigation of Donati's on the time of appearance of the great aurora of February 4, 1872, in which he shows that it did not appear everywhere really simultaneously, but *at the same local hour*, as if it depended, like celestial phenomena, on something fixed and external to the earth and its rotation. If this were more than a mere coincidence it would be of the utmost importance, as proving the cosmical character of the aurora, and it is very desirable that the investigation should be repeated as soon as a sufficiently extended display presents the opportunity. Probably there is already such information stored in meteorological registers for whoever will take the trouble to seek it out.

In Chapter VII. some observations of the moon during eclipse are described, and it is suggested that the curious red lighting of the shadowed portion may be due to lunar aurora. Spectral observations, however, seem to lend no support to the theory. It is noted that the colours of Jupiter's bands seem brightest during periods of auroral frequency.

The suggested connection between auroræ and zodiacal light is dismissed as unfounded, the latter evidently being some form of reflected sunlight, and having a totally different spectrum. The relation of the aurora to the solar corona seems almost equally shadowy, depending solely on a supposed coincidence of *one* of the lines in the coronal spectrum with a faint band of doubtful position in that of the aurora. We entirely sympathise with the author in his protest against the identification of spectra by the mere coincidence of *single* lines. Such coincidences within the limits of observation with instruments of small dispersion are exceedingly numerous, and the only safe ground of identification is that of likeness of general features, or at least coincidence of many lines.

The latter half of the volume is mainly devoted to the discussion of the auroral spectrum and its supposed coincidences. A reference to the plate and catalogue of auroral lines (p. 104), however, is sufficient to show that it is little use as yet to compare these measures with the accurate determinations of solar and spark lines, only one line out of the nine or ten given being positioned with any approach to accuracy or general agreement of the observers, even to the third figure. It is much to be hoped that Mr. Capron's suggestion of photographing the spectrum may prove practicable, and after his extraordinary success with the lines of vacuum tubes, as evidenced in his recent work on "Photographic Spectra," we can hardly doubt it. Dry plates are now prepared of extraordinary sensitiveness, and there is practically no limit to the time of exposure which may be employed.

We may briefly summarise, however, the results of comparison, so far as it is possible to compare with such defective measures.

Perhaps the first supposed identification of the auroral spectrum was that of Procter, who announced the correspondence of the bright yellow-green line with a band in a vacuum tube, which he supposed to be due to oxygen, but afterwards ascribed to a hydrocarbon impurity. We should not allude to this here, since the correspondence broke down under high dispersion, the auroral line proving slightly more refrangible than that of the tube; but that we wish to give a word of explanation as to the constant recurrence of these carbon lines, which have proved misleading to many experimenters. As is well known, the glass tubes and apparatus employed in such researches are made by the use of a blowpipe fed with coal-gas. The imperfectly burnt products of combustion inevitably pass into the comparatively cool glass tubes, and some of them, such as naphthalene, being of high density, they are condensed on the inner surfaces, and obstinately retained. When, however, they are subjected to the high vacuums of the Sprengel pump, they slowly volatilise, and being good conductors of the electrical discharge, become frequently so brilliant as completely to mask the spectrum of the small residue of other gas in the tube. By heating the tube strongly during exhaustion and "washing out" many times with the pure gas of which the spectrum is desired, these accidental spectra

[1] *Friends' Schools Nat. Hist. Journ.*, November 15.

may be got rid of, or at least, so much paled as to betray their character as interlopers. This, however, is an amount of labour hardly to be expected of those who make tubes in a commercial way, and it is to be regretted that in Mr. Capron's painstaking research, he was compelled to employ such tubes instead of preparing them for himself. In a future research we would suggest the employment of tubes thoroughly heated and washed out with air in the first instance, and then worked with a blowpipe fed with pure hydrogen.

Unfortunately throughout, the tubes employed both by Mr. Capron and by Dr. Vogel seem to have been of doubtful purity. That figured on plate xiv. as hydrogen, contains bands of most suspicious resemblance to those of nitrogen, while the oxygen tubes, beside the one or two lines which seemed peculiar to themselves, gave others which were proved by direct comparison, to coincide with those of carbon and hydrogen, though the relative intensities seemed somewhat altered.

Supposed coincidences have been pointed out by Angström, Vogel, and others, between the auroral spectrum and those of the various gases, such as oxygen, nitrogen, and hydrogen, which are present in the atmosphere. Unfortunately these coincidences do not extend to the one bright line which has been accurately measured, but only to the fainter ones, the positions of which are so doubtful that they might be made to correspond with any spectrum the lines of which were tolerably numerous, so that, intrinsically probable as they may be, we cannot regard them as positively established.

Absolutely no coincidence has been made out between the bright yellow-green line of the aurora and a principal one of any other known spectrum, and the same may be said of the sharp red line which occasionally flashes out in the spectrum, of red auroræ. Mr. Capron, however, points out that the green line coincides with a faint atmospheric absorption band, while the red line seems to occupy the position of the well-known *a* line of the solar spectrum, which Prof. Smyth has shown to be due to dry air.

It would not be fair to conclude our notice of "Auroræ" without a few words of praise to the admirable illustrations, several of which are chromolithographs. Of these perhaps the best in artistic effect is a facsimile of a water-colour drawing of a white aurora seen by the author at Kyle Akin in Skye. But in fact the whole appearance of the book suggests at first glance art rather than science, and we should suppose it is but rarely that a purely scientific treatise has appeared in so ornamental a dress.

OUR BOOK SHELF

A Treatise on Metalliferous Mines and Mining. By D. C. Davies, F.G.S. 8vo. (London: Crosby Lockwood and Co., 1880.)

THE objects of this book, as stated in the preface, are "to describe in a concise and systematic manner the conditions under which metallic ores are found in different countries in the world," and further, "by defining the zones occupied by the various metallic ores to lessen somewhat the amount of unsuccessful search for them." For the first purpose the author notices a large number of mines in various parts of the world, partly from his own observations and partly from accounts published in special journals and in the transactions of scientific societies; and for the second, he deduces from such descriptive matter certain general conclusions, which, in their more important points, are as follows:—

"Gold and silver never occur in strata newer than the carboniferous period."

"Copper ores with trifling exceptions are only found in the lower Cambrian carboniferous and new red sandstone formations."

"The highest horizon of lead ores is in the carboniferous limestone."

The conclusions are apparently derived from the study of phenomena in Wales, and to render them universally applicable all that is necessary is to reconstruct the geology of the rest of the world to suit them, which the author does in a thorough-going fashion. Thus the system requires for Cornwall that the age of the granites should be Laurentian, and the killas and other schistose rocks Cambrian, Silurian, Devonian, &c., in regular succession; and therefore the author concludes that the received view which makes the granite post-carboniferous is a mistake, and corrects his authorities accordingly, even when quoting their observations. Thus in reproducing Dr. Foster's account of the Hay Tor iron ores he disputes their probable carboniferous age, and states that they may belong to an older group, and that possibly of a still older age are the deposits of the West of Ireland, which are found interstratified on the basaltic and porphyritic rocks that skirt the west coast. It appears from a preceding page that by these are meant the iron ores of Antrim, which occur in miocene basalts on the north-east coast between Larne and the Giant's Causeway, and about whose age no question can possibly be raised by any one with the smallest geological knowledge.

Much of the information concerning foreign mines is exceedingly inaccurate, indeed it is difficult to see whence some of it is derived. For example, on p. 240, in a paragraph describing the zinc ores of Silesia, it is stated that the calamine of that country averages 20 to 30 per cent. of metallic zinc, which by selection and dressing is brought up to 70 per cent.; that in 1876 sixty-four mines produced 31,315 tons of zinc ore, and a reference to a paper by Huene in the *Journal* of the German Geological Society is given as an authority. As these statements are contrary to what is generally known upon these subjects, an attempt has been made to verify them; and it appears that (1) the average yield of the Silesian zinc ores in 1876 as smelted was 11·84 per cent.; (2) the production of zinc ores in Silesia in 1876 was 449,374 tons; (3) the paper by Huene, published in 1851, has nothing whatever to do with Silesia, as it describes some zinc mines at Bergisch-Gladbach near Cologne.

The above examples taken quite at random will be sufficient to show the generally untrustworthy character of the book. H. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Why the Air at the Equator is not Hotter in January than in July

THE following, I think, is the explanation of Mr. Fisher's difficulty (NATURE, vol. xx. p. 577), why the January temperature at the equator when the earth is in perihelion is not much higher than in July when in aphelion. The temperature to which Mr. Fisher refers is the ordinary temperature as indicated by the shade thermometer, which of course is simply that of the air. The difficulty is more apparent than real, for if we examine the *indirect* results which follow from the present distribution of land